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1 Introduction

In 2001, the governors of Oregon and Washington appointed a Task Force to identify transportation improvements that would relieve the increasing congestion on I-5 in the Portland/Vancouver area. In 2002, the Task Force completed the initial phase of the Portland/Vancouver I-5 Transportation and Trade Partnership Project and published its recommendations in *The Portland/Vancouver I-5 Transportation and Trade Partnership Strategic Plan.* Since that time additional analysis has been done on project options. Beginning in 2005, an Environmental Impact Statement (EIS) will be prepared, which will further analyze project alternatives.

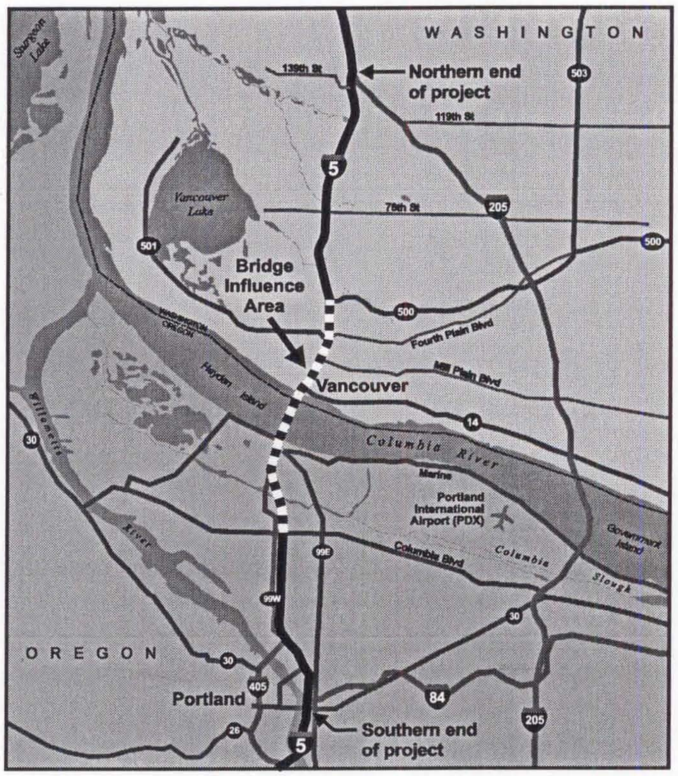

Figure 1. The I-5 Corridor and the Bridge Influence Area (BIA) as defined in the I-5 Transportation Study.

The Task Force investigated a 15-mile segment of I-5, referred to in the project as the I-5 Corridor. The segment begins at the I-205 interchange in Vancouver and ends at the I-84 interchange in Portland (Figure 1).

The I-5 Interstate Bridge across the Columbia River and about two and a half miles both north and south of the river were identified as having the greatest need for additional capacity and freeway access improvement. The five-mile stretch, referred to as the Bridge Influence Area (BIA), begins at SR 500 in Vancouver and ends at Columbia Boulevard in Portland (Figure 1).

The Task Force developed a number of river crossing improvement concepts, all of which involve either replacing the existing river crossing or adding a supplemental bridge, bridges, or tunnel. Because funding for a new bridge across the Columbia River is currently not available, tolling may be a viable option for generating the necessary revenue to build, operate, and maintain a new bridge or bridges.

In 2004, a study was undertaken to determine, on a conceptual level, the benefits and effects of tolling the Columbia River Crossing. Specific objectives were to evaluate the effects on traffic from tolling, identify potential sites for toll plazas, estimate the costs of tolling, and forecast revenues. The following guidelines were followed:

- Recommendations should be sensitive to transportation policies in the *2000*

Regional Transportation Plan. Policy 19.2, Peak Period Pricing, which states objectives related to peak-period pricing when major new highway capacity is being added, including the potential for pricing all lanes for new or major reconstructed facilities.

- Within the framework of federal, state and regional policies, tolling options should have the potential to provide sufficient revenue to recover capital, maintenance, and operational costs of the new facilities.
- Tolling options should consider the findings and recommendations from the Strategic Plan.
- The range of tolling options evaluated in the EIS should raise sufficient funds to support the project alternatives that are also being evaluated in the EIS.

The effort resulted in18 working papers and two technical memoranda. This document presents a summary of that work. The working papers and memoranda are included as part of this document on a CD, and the appendix contains a list of the documents.

2 River Crossing Improvement Concepts

The Bridge Influence Area (BIA) has the heaviest concentration of traffic within the I-5 Corridor and the six-lane I-5 bridge (three lanes in each direction) is a significant bottleneck. The eight interchanges within the five-mile BIA are also a major issue due largely to substandard merging, diverging, and weaving.

In the I-5 Transportation Study, eight river crossing improvement concepts were developed and, of those, four were selected for preliminary design. Concepts 1, 4, 6, and 7 all contain a replacement or supplemental bridge, ten lanes (five in each direction) with various combinations of lane types (through, arterial, and/or collector-distributor), and two light rail transit (LRT) tracks. See Figures 2 thru 5.

The Task Force concluded that the river crossing should include ten lanes (three through-lanes and two auxiliary/arterial lanes in each direction) and LRT tracks. The Task Force did not adopt or rank any of the river crossing concepts but recommended further evaluation of:

- replacement vs. supplemental bridge
- joint-use (through-lane/LRT) bridge vs. separate bridges
- eight-lane bridge and joint-use (two arterial lanes/LRT) bridge
- HOV throughout the I-5 Corridor

The Task Force recommended that several improvement options that affect the

BIA not be carried forward into the EIS: a tunnel under the river, a collector-distributor (C-D) system on the bridge, and four or more through-lanes (in each direction) corridor-wide.

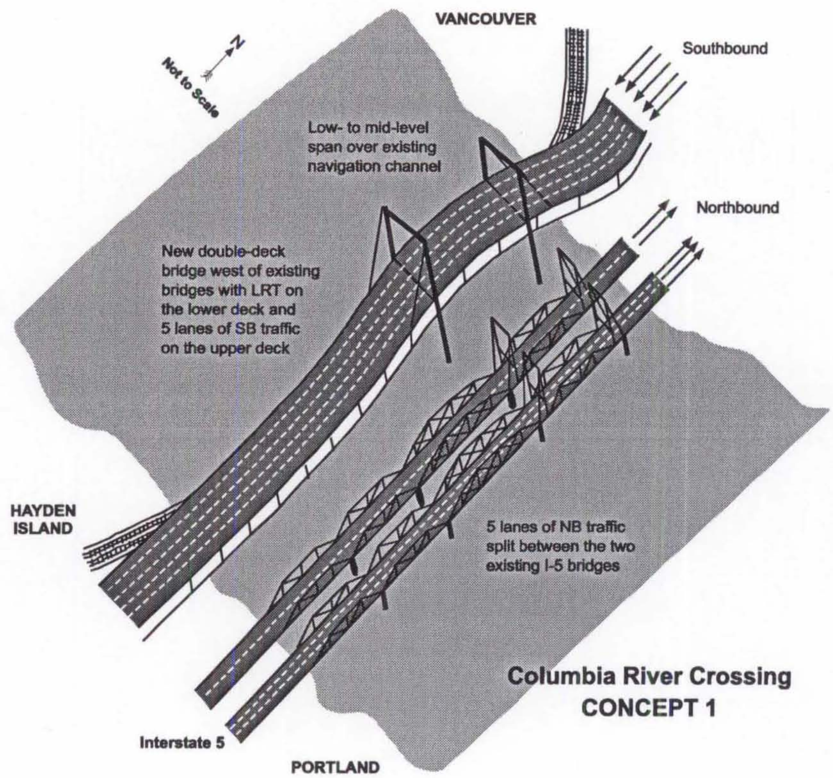

Figure 2. Concept 1: Ten through-lanes and two LRT tracks. Northbound traffic is on the existing facility, Southbound traffic is on a new, supplemental bridge west of the existing facility, and LRT is on the lower deck of the supplemental bridge.

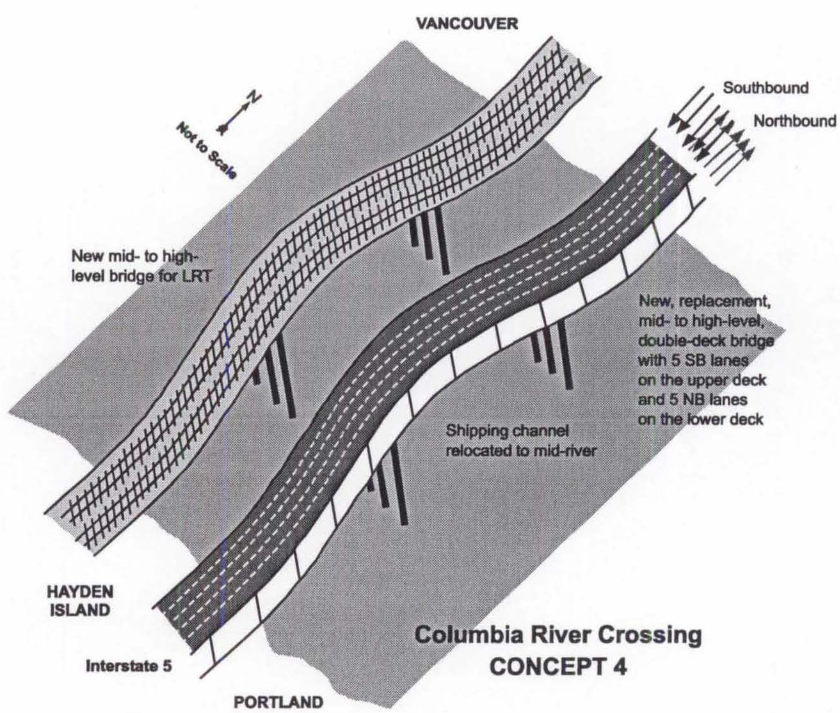

Figure 3. Concept 4: Ten through-lanes and two LRT tracks. The existing facility is replaced with a double-deck bridge. Northbound traffic is on the upper deck, and southbound is on the lower deck. LRT tracks are on a new bridge west of the replacement bridge. The navigational channel is shifted to mid-river, and a bridge with a lift span is not required (this concept is the only one of the four with these two features).

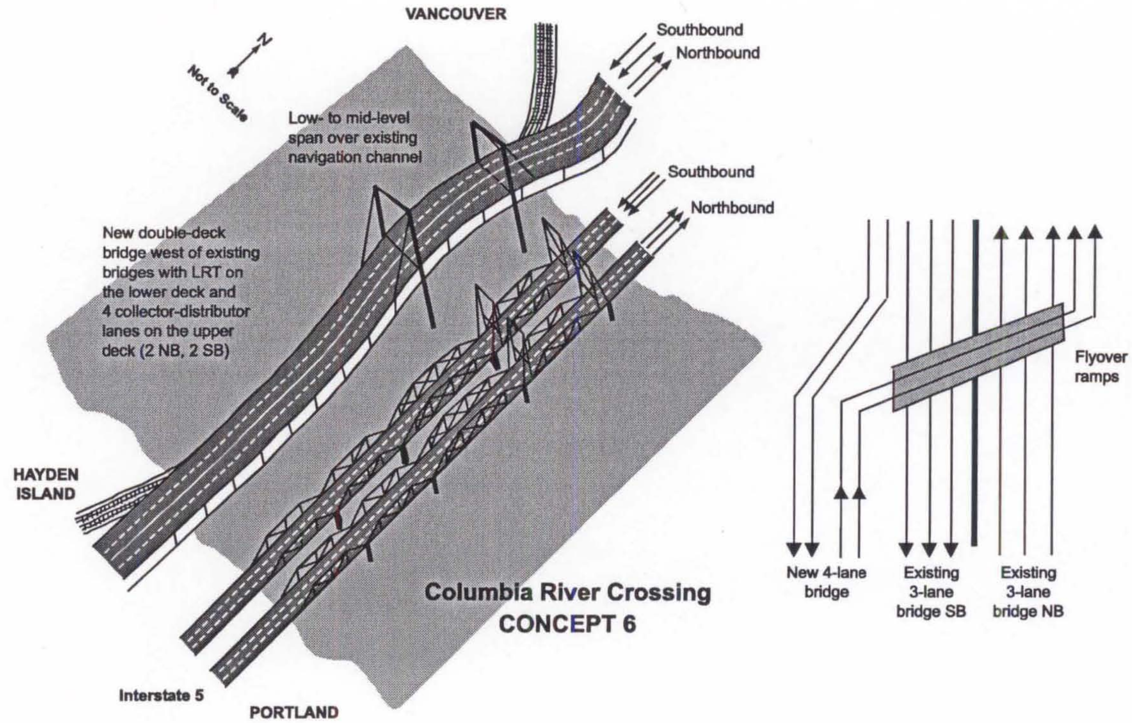

Figure 4. Concept 6: Ten lanes (six through-lanes, a four-lane collector-distributor system) and two LRT tracks. Northbound and southbound through-lanes are on the existing facility. The collector-distributor lanes and LRT tracks are on a new, supplemental bridge west of the existing facility. (A collector-distributor lane separates on- and off-ramp traffic from the mainline. It allows off-ramp traffic to decelerate safely and on-ramp traffic to accelerate and collect before merging with mainline traffic.)

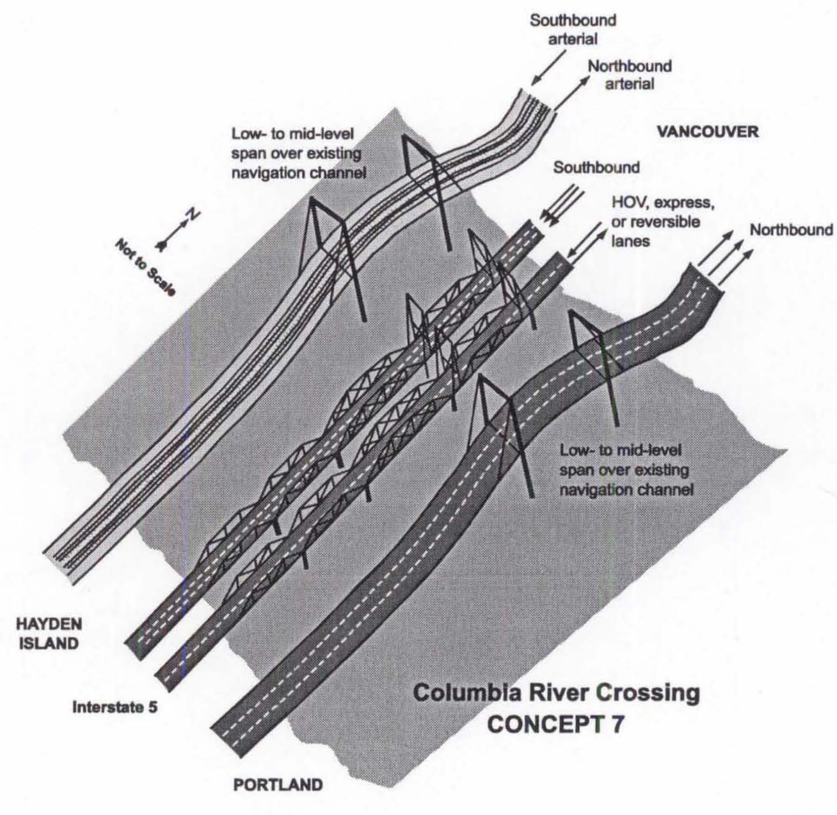

Figure 5. Concept 7: Ten lanes (six through-lanes; two HOV, express, or reversible lanes; and two arterial lanes), and two LRT tracks. Northbound through-lanes are on a new, supplemental bridge east of the existing facility. Southbound through-lanes and northbound and southbound HOV, express, or reversible lanes are on the existing facility. Arterial lanes and LRT tracks are on a new, supplemental bridge west of the existing facility.

3 Toll Plaza Design

3.1 Toll Plaza vs. 100% ETC

Tolling the I-5 Columbia River Crossing would require one or more toll plazas. Toll plazas would not be necessary if all vehicles were equipped with transponders and tolls were paid using high-speed electronic toll collection (ETC) lanes, but this may not be feasible because:

- a transponder-ETC usage rate higher than 60% is difficult to achieve (our 2020 ETC market share is projected to be 64%...)
- non-transponder ETC is prohibitively expensive
- privacy issues and the lack of national standards for dedicated short-range communication protocols make it unlikely that all vehicles manufactured in the U.S. will be equipped with universal transponders within the next ten years.

3.2 Toll Plaza Design Parameters

There are currently no design standards for toll plazas. In 1997, the Transportation Research Board published guidelines based on design practices that have been used in tolling facilities throughout the U.S. (Schaufler, 1997), and in 2001, McDonald and Stammer published toll plaza design guidelines in the *Journal of Transportation Engineering*.

It is recommended that a toll facility for the Columbia River Crossing adhere to these guidelines. Deviations may be necessary because the potential toll plaza sites are all in an urban setting where space is limited. Deviations would need approval from the state with jurisdiction (Washington or Oregon) and the Federal Highway Administration (FHWA).

Figure 6 shows the basic components of a mainline toll plaza. Table 1 lists the design parameters that are recommended for Columbia River Crossing toll facilities.

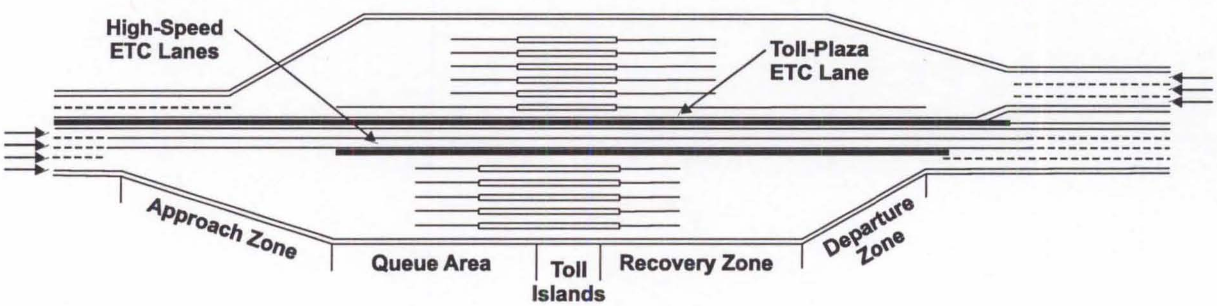

Figure 6. Basic components of a mainline toll plaza: an unstriped approach zone where vehicles maneuver from the mainline lanes into toll lanes, a queue area where vehicles wait for toll collection, a toll island slab where toll collection points are located, a recovery zone where vehicles exit the toll collection point, and an unstriped departure zone where vehicles maneuver back into the mainline lanes. The plaza also has signing, lighting, and other facilities. After McDonald and Stammer, 2001.

Table 1. Recommended toll plaza design parameters for the Columbia River Crossing.

Administration building	• Within 100 ft of toll barrier • Compatible in design and landscaping with surrounding environment • In compliance with ADA
Air quality	• Emissions modeling to ensure compliance with Clean Air Act Amendments • Vent emissions away from tollbooths
Approach zone taper rate	• 21:1 for an entry speed of 55 mph • 9:1 for an entry speed of 30 mph
Departure zone taper rate	• 9:1 or less
ETC lanes, high-speed	• Located on the left inside lanes • Separated from non-ETC lanes by a barrier wall • Cross-section from the median barrier for two ETC high-speed lanes: 4-ft shoulder on the left, two 12-ft lanes, and a 10-ft shoulder on the right for a total pavement width of 38 ft • Signing far in advance of the toll plaza
Lane configuration	• Higher-volume lanes on the left • Tandem and/or branch toll lanes if needed
Lane width	• 11 ft with at least one 14-ft lane for wide loads
Lighting	• High levels for safety and to help reduce entry speed • Shielding and proper light direction to prevent light spillover
Noise	• Maximum ETC market share to reduce noise • Mitigation such as noise wall, berms, and soundproofing
Queue area length	• 250 ft
Recovery zone length	• 150 ft
Surface water runoff	• Treatment of surface water runoff
Toll island dimensions	• Width 6.5 ft and length 100 ft
Toll plaza size (footprint)	• Maximum ETC market share to reduce footprint • Tandem and/or branch toll lanes if needed to reduce footprint
Tollbooth	• 3.5 ft wide • In compliance with ADA (possibly)
Tollbooth access	• Safety and security are primary issues • Minimal number of toll lanes that toll collectors must cross to access tollbooth • In compliance with ADA (possibly)

4 Potential Toll Plaza Sites

Because it was anticipated that tolling the I-5 bridge would cause some traffic to divert to a toll-free I-205 Glenn Jackson Bridge,[1] tolling both bridges in one direction was considered, and potential sites for toll plazas near both bridges were investigated. Five sites were identified—three on I-5 and two on I-205. The sites are described below, followed by recommendations for the four I-5 river crossing concepts and the I-205 bridge.

No attempt was made to evaluate the environmental impacts of the sites, but it

[1] Shortened in this document to I-205 bridge.

should be noted that for most toll plazas these are significant.

4.1 Toll Plaza Site #1

Toll Plaza Site #1 would accommodate a southbound mainline toll plaza on I-5 at East Mill Plain (Figure 7). This toll facility would not capture all of the southbound bridge traffic because there are other I-5 on-ramps between the East Mill Plain Interchange and the bridge, notably at SR 14. These ramps would be tolled separately with tolling facilities located within the existing ROW (Figure 8).

Siting a ramp toll plaza on the southbound on-ramp from SR 14 would require a major redesign of the ramp because of the steep grade and sharp curve radius. Toll collection could also take place on SR 14 in advance of the connection with I-5.

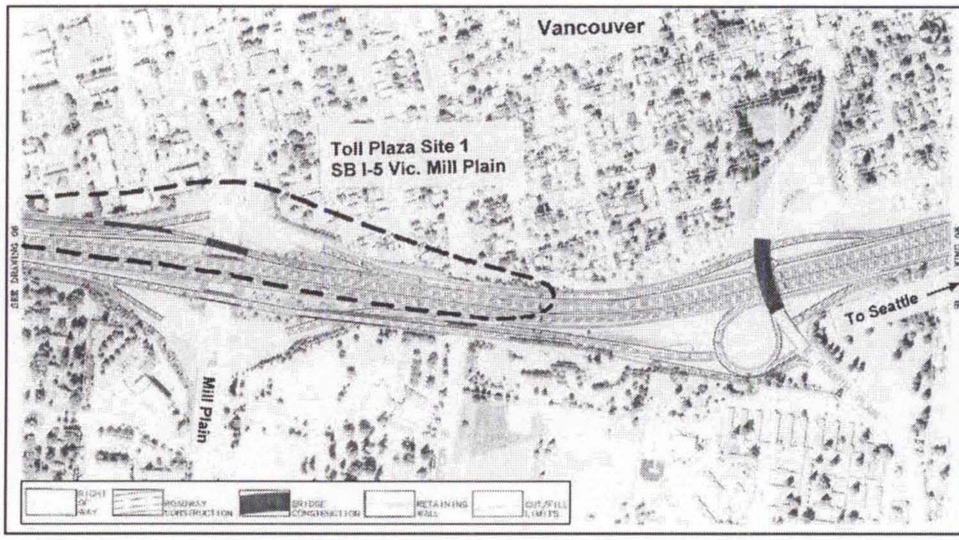

Figure 7. Toll Plaza Site #1 at the southbound East Mill Plain Interchange in Washington.

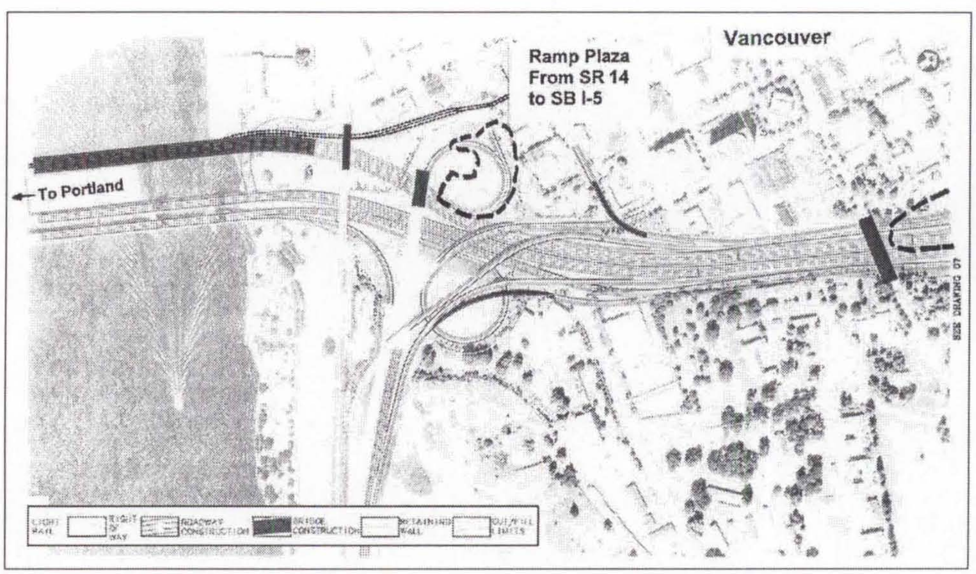

Figure 8. Ramp plaza from SR-14to southbound 1-5 for Toll Plaza Site #1.

4.2 Toll Plaza Site #2

Toll Plaza Site #2 would accommodate a southbound mainline toll plaza on I-5 within the SR 14 Interchange (Figure 9). This toll facility would capture all of the southbound bridge traffic because SR 14 is the last interchange before the river. Additional ramp tolling facilities would therefore not be needed. To reduce the mainline plaza footprint some of the tollbooths could be located on the SR 14 ramp where it connects with I-5 (Figure 10).

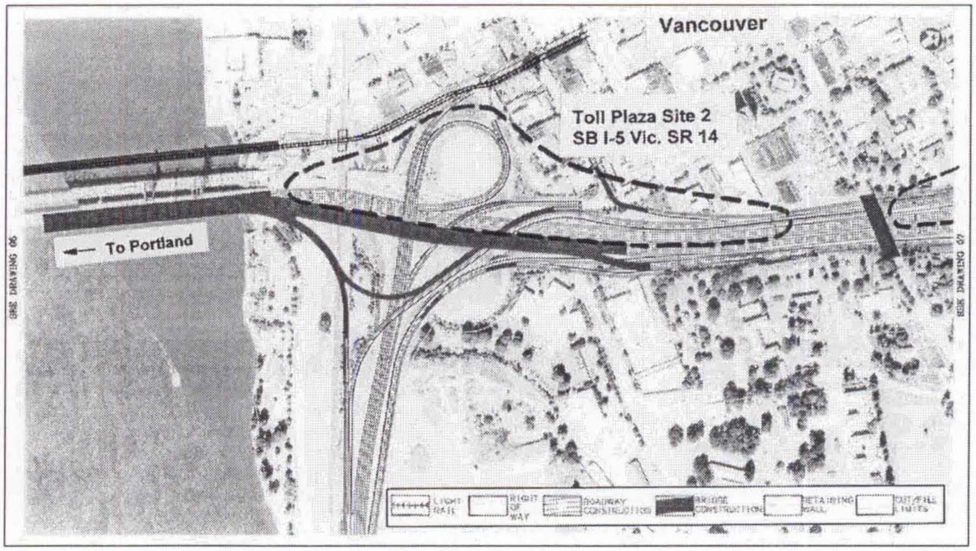

Figure 9. Toll Plaza Site #2 within the SR 14 Interchange in Washington.

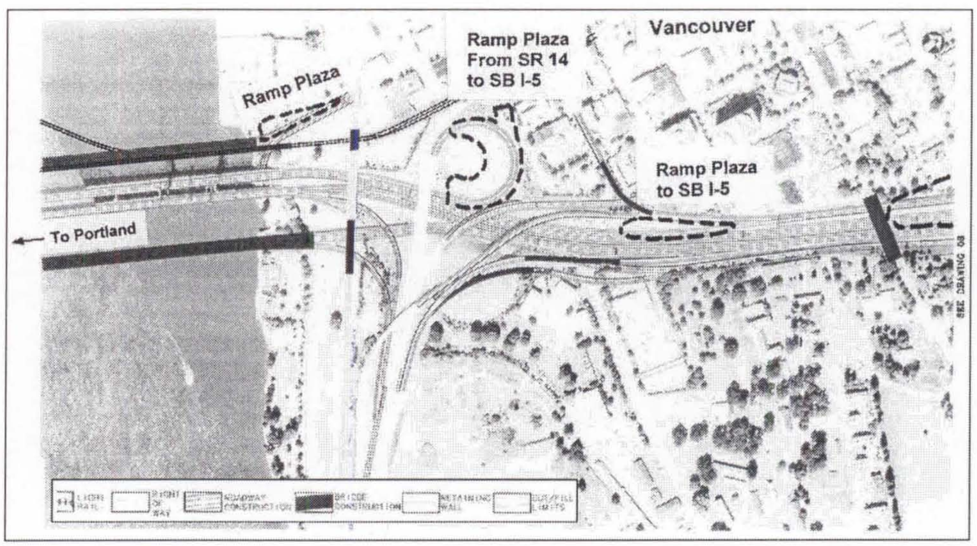

Figure 10. Ramp plazas for Toll Plaza Site #2 within the SR 14 Interchange in

A redesign of the SR 14 Interchange would be required to accommodate the plaza due to conflicts with the existing ramp layouts. Toll plaza approach and departure zones would require additional ROW and would likely impact the Burlington Northern and Sante Fe (BNSF) railway overcrossing.

4.3 Toll Plaza Site #3

Toll Plaza Site #3 would accommodate a southbound mainline toll plaza on the west side of I-5 on Hayden Island (Figure 11). The southbound off-ramp to Hayden Island would need to be tolled separately.

Of the five toll plaza sites, this is the most expensive because of site constraints combined with the need to provide access to and from the island and the LRT stop.

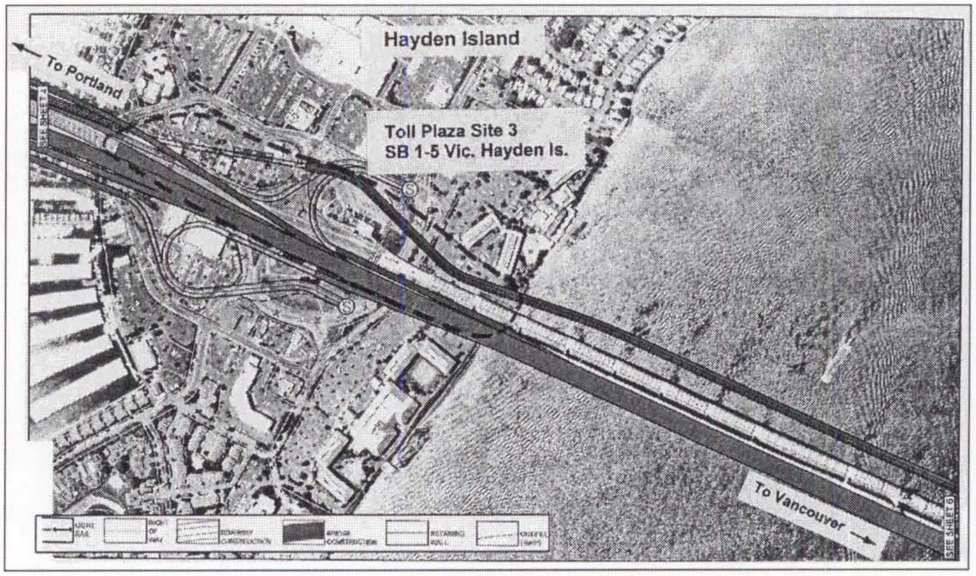

Figure 11. Toll Plaza Site #3 on the west side of I-5 on Hayden Island.

4.4 Toll Plaza Site #4

Toll Plaza Site #4 would accommodate a southbound mainline toll plaza on I-205 near the SR 14 overcrossing in Washington (Figure 12).

A toll plaza at this location would require reconstructing the SR 14 interchange ramps. I-205 connector ramps for the interchanges north of the SR 14 overcrossing are scheduled for major reconstruction under a separate project currently under development by WSDOT. Planned collector-distributor ramps for this future project north of SR 14 will use all available ROW, which would affect siting a toll plaza at this location. The portion of the toll plaza that is south of SR 14 would be on structure because the existing bridge touches down at the north side of the SR 14 overcrossing. Since no other reconstruction work is proposed for I-205 in the area of the toll plaza, the estimated cost for the toll plaza includes necessary ramp modifications. A design that deviates from toll plaza design guidelines would be needed to accommodate the site constraints.

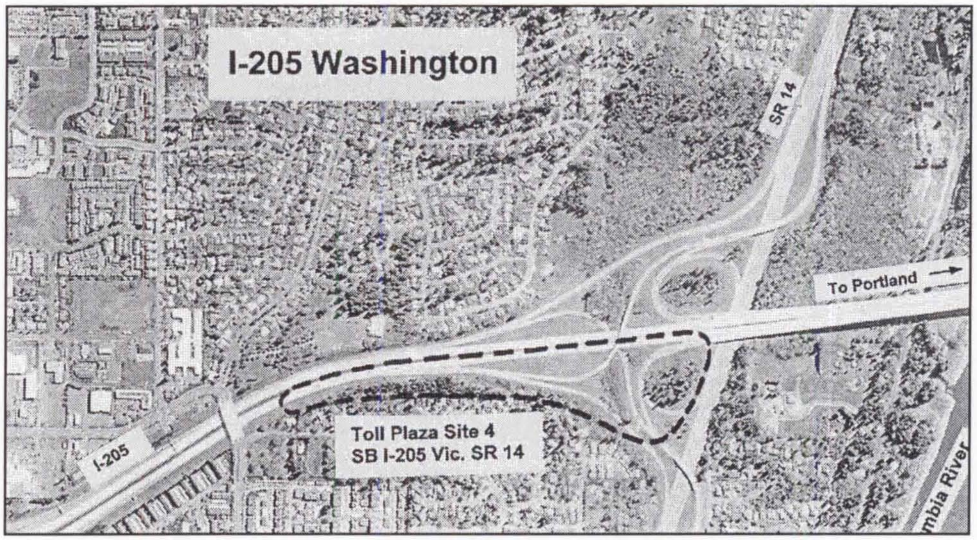

Figure 12. Toll Plaza Site #4 near SR 14 on I-205.

4.5 Toll Plaza Site #5

Toll Plaza Site #5 would accommodate a southbound mainline toll plaza on I-205 within the Airport Way Interchange in Oregon (Figure 13). The toll plaza site would need to be "squeezed" between the Columbia River on the north and the LRT connection to the south. New ramp connections to the Portland International Airport would be required, as well as southbound I-205 connections to Airport Way. The southbound I-205 connection to the airport would require tolling on the off-ramp because the mainline toll barrier would be farther south on I-205.

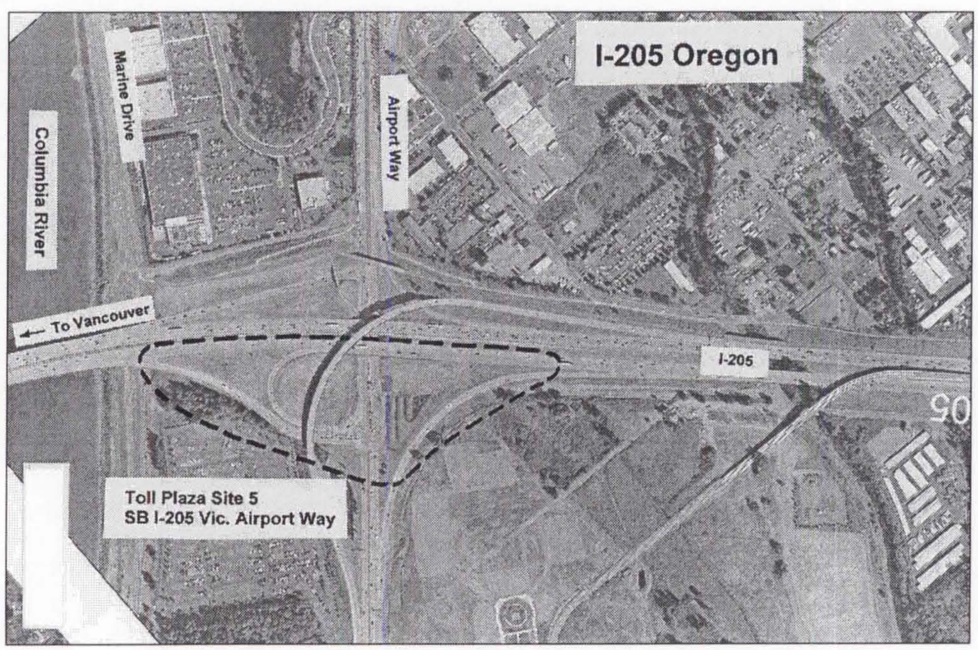

Figure 13. Toll Plaza Site #5 within the Airport Way Interchange on I-205.

4.6 Toll Plaza Footprint, ROW and Cost

Table 2 lists the estimated number of lanes, footprint, right-of-way (ROW), and cost for the five potential toll plaza sites identified in this study. The estimated costs are conceptual and should be used for comparison purposes only. Cost estimates do not include maintenance or operation (these costs are included in the toll revenue projections in Section 8.3).

Table 2. Estimated number of lanes, footprint, ROW, and cost for the five potential toll plaza sites. (Y-2004 $)

oll plaza site	Number of lanes: ETC	Number of lanes: Tollbooths	Footprint	ROW	Additional ramp toll plaza required?	Cost (not including ramp toll plaza)
#1	2	10	11 acres	6–7 acres	Yes	$120–$165 m
#2	3	15	10 acres	6 acres	No	$135–$175 m
#3	3	14	10 acres	11 acres	Yes	$200–$250 m
#4	TBD*	TBD	12 acres	3 acres	No	$110–$130 m
#5	TBD	TBD	13 acres	4 acres	Yes	$125–$150 m

* To be determined

4.7 Toll Plaza Site Recommendation for Concept 1

A supplemental bridge west of the existing bridges would complicate siting a toll plaza. The best location for a toll plaza for Concept 1 appears at this initial stage to be Toll Plaza Site #1, the southbound East Mill Plain Interchange in Washington.

4.8 Toll Plaza Site Recommendation for Concept 4

There are three potential sites for a southbound toll plaza for Concept 4: Toll Plaza Sites #1 and #2 in Washington and Toll Plaza Site #3 in Oregon. All of the sites would require a redesign of Concept 4 to verify their feasibility and innovative approaches to allow for smaller footprints than are recommended by toll plaza design guidelines.

If tolling in both directions on I-5 is recommended, the most likely site for a combined northbound and southbound plaza for Concept 4 appears to be on Hayden Island, but a major redesign of Concept 4 in this area would be required. Further analysis would also be required.

4.9 Toll Plaza Site Recommendation for Concept 6

No feasible sites for a toll plaza have been identified for this concept. If tolling the I-5 Columbia River Crossing is proposed in the EIS, this concept may have to be eliminated from further consideration.

4.10 Toll Plaza Site Recommendation for Concept 7

Siting a toll plaza in Concept 7 would be more difficult than for Concept 4. At this initial stage, it appears that siting a southbound toll plaza would be more cost-effective in Washington (at Toll Plaza Sites #1 or #2) than in Oregon.

4.11 Toll Plaza Site Recommendation for I-205

The best location for a toll plaza on I-205 at this initial stage appears to be a southbound plaza within the SR 14 Interchange in Washington (Toll Plaza Site #4). The Washington site allows for better approach tapers to the toll barrier compared to the Oregon side where the approach tapers would need to extend well onto the Glenn Jackson Bridge.

Siting a toll plaza on Government Island should be investigated.

5 Toll Rate Structure

Based on the objectives identified for this study and common practices for toll facilities in the U.S., it is recommended that a tolling policy for the Columbia River Crossing include the following elements:

- Rate differential based on type of vehicle. Different tolls are charged to vehicles based on their classification. Passenger cars would typically pay a lower toll than commercial vehicles.
- Rate differential based on time of day. Toll rates are set based upon the value of the trip, with peak hour trips typically priced higher than off-peak trips.
- Discounts for Electronic Toll Collection (ETC). Discounts are used to encourage increased use of ETC lanes.
- Discounts for HOVs~~S~~. Discounts for HOVs are used to encourage carpooling.
- Toll escalation. Toll rates are increased over time to reflect inflation and to properly price the value of the trip.

It is also recommended that the EIS evaluation study a base toll rate that would be established and be determined by the amount of toll revenue that could be collected annually versus the relative capital program to be supported by the tolls. Policy variations of this base case could then be tested to respond to the region's fiscal and policy needs.

Table 3 lists the toll structure options for tolling the Columbia River Crossing that are recommended for further study in the EIS.

Table 3. Recommended toll structure options for the Columbia River Crossing.

Tolling Option	Recommendation for Further Study
Rate differential based on type of vehicle	Commercial vehicle classification system based on height and axle, using an (N-1)*(passenger car rate) toll (for forecasting revenue in this study)
Rate differential based on time of day (variable pricing)	Constant pricing (for forecasting revenue in this study). Variable pricing such as a peak-hour surcharge can be introduced later to reduce travel demand and/or increase revenues.
Electronic Toll Collection (ETC) discounts	15% for passenger and commercial vehicles and 100% for transit vehicles.
High Occupancy Vehicle (HOV) discount	HOVs are defined as vehicles with three or more people. HOVs equipped with ETC tags receive a 50% reduction of the ETC rate.
Toll escalation	3% increase per year with rate increases every two or three years in 25-cent increments (for forecasting revenue in this study).

6 Electronic Toll Collection

The average ETC market share for tolling facilities that have been studied is 25 to 30% for the opening year, 35 to 45% three to five years after opening, and 50 to 60% five to ten years after opening. For purposes of evaluating toll plaza configurations in this study, a 40% ETC market share was used.

Administrative ETC services such as marketing, account management, tag distribution, performance tracking, and revenue handling are provided by a Customer Service Center or by an outside agency on a contractual basis. For revenue projections, a per-transaction fee of 20¢ was used.

7 Traffic Analysis Methodology

In the Portland/Vancouver area, travel demand forecasts are provided by Metro (Portland's metropolitan planning organization). Metro's regional travel demand model, Emme/2, uses a variety of data to forecast travel demand in the region. Data include transportation network information, such as roadway capacity and transit service, and socioeconomic information, such as households and employment. Forecasts consist of a variety of results, including traffic volumes, travel speeds, and trip patterns.

The I-5 Transportation Study used travel demand forecasts generated by the Emme/2 model for both the I-5 and I-205 corridors. The study evaluated a number of transportation options including the 2020 No-Build and the 2020 Build Options.

In the 2020 No-Build Option, no capacity is added to either I-5 or I-205, with the exception of widening I-5 at Delta Park to add a third southbound lane on I-5 between Victory Boulevard and Columbia Boulevard.

In the 2020 Build Option, capacity on I-5 in the BIA is increased. The option includes making various operational and capacity improvements to I-5 and the interchanges within the BIA and providing up to ten lanes on an I-5 river crossing either by replacing the existing six-lane bridge or by building a supplemental one.

This tolling study used the travel demand forecasts from the I-5 Transportation Study as a basis for projecting traffic volumes and revenues if the I-5 Interstate Bridge, and possibly also the I-205 Glenn Jackson Bridge, are tolled in the 2020 Build Scenario.

Traffic data were generated using the Emme/2 regional travel demand model with origin/destination information as the foundation for the forecast traffic volumes. AM Peak, PM Peak, and off-peak periods were treated separately, and each of the time periods was broken down into work trips, non-work trips, and truck trips to estimate which drivers would likely pay a toll to cross the river and which would either divert or eliminate the trip.

Peak-period and daily traffic volumes across both bridges in a toll-free condition were forecast. The Emme/2 model provided year 2020 3-hour AM and 4-hour PM peak-hour volumes. These were desegregated into peak-hour volumes and adjusted to account for the differences between actual existing traffic count data and the model's prediction of existing volumes.

The toll-free forecasts were used along with a select-link analysis for various vehicle-trip types to estimate traffic volume shifts and tolling revenue if one or both bridges were tolled. Three trip types were used: work, non-work and truck trips. The select-link analysis was used to break down the trips on each bridge by the individual origin and destination pairs (O/D) using I-5 and I-205 under toll-free conditions.

The tolling analysis was segmented by vehicle classification and payment methodology. Toll rates were applied using rate options discussed earlier. Discounts for ETC and HOV were applied as well as the rates for commercial vehicles. A base toll rate of $2 in 2004 dollars with a toll escalation in 25¢ increments, mimicking a 3% inflation rate, was assumed. A base toll rate of $2 was selected as a starting point based on a rough estimate that between $1 billion and $1.5 billion would need to be generated to cover project capital costs. The year of opening for the new I-5 facility was assumed to be 2013 at which time tolling would begin.

7.1 Metroscope

Since the I-5 Transportation Study was completed, Metro has done some comparative modeling of increased capacity within the BIA using Metroscope, a new model developed by Metro. This makes it sound like a new modeling tool that we've never discussed previously (or seen). Metroscope differs from traditional travel demand models in that it iteratively allocates household and employment forecasts based on, for example, land availability, redevelopment potential, accessibility, and land costs when predicting travel demand. It's a demand model? Traditional models such as Emme/2 hold household and employment forecasts constant when predicting travel demand. Very confused about what metroscope is and why it would be brought into the exec sum as something new that hasn't been discussed previously?

During the preparation of this tolling study, Metro ran the Metroscope Generation 2 model for 2020. The river crossing data for 2020 were similar to river crossing data from the Emme/2 model for 2020. The Metroscope model predicted higher household and employment growth in Clark County than was assumed for the Emme/2 model and used in the I-5 Transportation Study (and this study). The Metroscope model predicted that Clark County's employees-per-household rate would increase and that the number of Clark County workers who would stay within the county for work would increase, thus decreasing the number who would use either the I-5 bridge or the I-205 bridge for work. However, according to Metro, Clark County's predicted growth in households would offset the increased in-county employment forecast. The number of trips in 2020 involving one or the other bridge would therefore be similar to the number predicted by Emme/2.

New travel demand modeling will need to be undertaken to support the development of the EIS for the Columbia River Crossing. Travel demand forecasts will need to be developed for conditions about 20 years after construction of the project, and forecasts will therefore likely to be needed for at least 2030. Prior to the initiation of modeling for the EIS, Metro and Clark County's Regional Transportation Commission will need to resolve potential household and employment forecast differences and agree on the appropriate models to use.

8 Traffic and Revenue Forecasts

8.1 Forecast Traffic Under a Toll-Free Condition

As discussed above, this tolling study used existing and forecast traffic data from the I-5 Transportation Study as a basis for projecting traffic volumes and revenues under tolled conditions. The data from the I-5 Transportation Study are under toll-free conditions because tolling as a funding option was not evaluated in that study.

During the last 10 years, traffic volume on the I-5 bridge has increased by about 15% and on the I-205 bridge by about 50%. The I-5 and the I-205 bridges currently (2004) serve up to 130,000 and 145,000 vehicles each weekday, respectively.

A synopsis of existing and forecast traffic volumes for the I-5 and I-205 bridges under Existing, No-Build, and Build conditions is presented in Table 4. Total combined daily volumes across both bridges are anticipated to increase by 14% over an 18-year period under the No-Build Option. With additional capacity across the I-5 Columbia River crossing, the forecast total daily volumes across both bridges would increase about 21%, a 6% increase for Build versus No Build. Compared to No-Build conditions, I-5's daily volumes under Build conditions would increase 27%,

Table 4. Existing and projected traffic volumes for the I-5 and I-205 Columbia River Crossings.

	AWD*			AM Peak			PM Peak		
Option	**I-5**	**I-205**	**I-5 + I-205**	**I-5**	**I-205**	**I-5 + I-205**	**I-5**	**I-205**	**I-5 + I-205**
Traffic volume									
Existing (2002)	124,000	136,000	260,000	22,500	28,700	51,200	35,800	43,100	78,900
2020 No-Build	140,400	155,200	295,600	24,800	32,700	57,500	39,400	49,200	88,600
2020 Build	178,600	136,100	314,700	33,600	28,300	61,900	53,300	42,250	95,550
Comparison of Existing and No-Build, Existing and Build, and No-Build and Build									
Existing to No-Build	+13%	+14%	+14%	+10%	+14%	+12%	+10%	+14%	+12%
Existing to Build	+44%	—	+21%	+49%	−1%	+21%	+49%	−2%	+21%
No-Build to Build	+27%	−12%	+6%	+35%	−13%	+8%	+35%	−14%	+8%

* Average weekday daily volume

while I-205's daily volumes would decrease by 12%. The added capacity in the I-5 corridor would result in some trips shifting from I-205 to I-5.

In the I-5 Transportation Study trip patterns within the BIA were analyzed. It was estimated that in year 2020, 70 to 80% of all traffic traveling on I-5 within the BIA would enter or exit I-5 using one of the eight interchanges within the five-mile stretch and about half would both enter and exit I-5 within the BIA.

8.2 Forecast Traffic and Revenue Under a Tolled Condition

Traffic and revenue forecasts were developed for two tolling scenarios: the Toll I-5 Only Scenario, in which the I-5 Columbia River crossing is tolled in both directions, and the Toll I-5 and I-205 Scenario, in which the I-5 and I-205 river crossings are both tolled, but in only one direction. The forecasts are preliminary and should be used for project scoping purposes only.

Conservative Forecasts. Traffic and revenue forecasts in this study may be conservative in part because the I-205 traffic volumes are forecast to increase at a lower growth rate from 2002 to 2020 than has been experienced over the past decade. Should not be labeled "conservative" Between 1993 and 2003, I-205's daily volumes increased an average of about 4.3% per year, but between 2002 and 2020 I-205's volumes are projected to increase an average of about 1% per year. The rate of traffic growth along I-205 is likely to be lower than was historically experienced because of projected shifts in land-use patterns and the I-205 bridge's peak-hour capacity constraint, i.e. by 2020 the bridge will be operating at near-capacity conditions during peak periods. Nonetheless, it is possible that I-205's traffic volumes could reach over 155,000 per day before 2020, under the No Build Option, if actual growth exceeds an average of 1% a year which the regional travel demand model predicts it will. (0.7% avg annual growth for I-5 ad I-205 no build toll free – where does the over 1% come in?)

Trip Diversion and Elimination. It is common in tolling studies to use "time-saved" criteria to estimate which drivers would likely pay a toll to use a facility and which would change travel patterns. For this study, a slightly different methodology was used to develop diversion criteria. For the Toll I-5 Only Scenario in which the I-205 bridge would remain toll-free, a surrogate was used for time saved by analyzing the existing and forecasted use of each facility by O/D pair. By summarizing total river crossing traffic by O/D and trip type and determining the toll-free forecast share of each facility, the model estimated which route was the most efficient for any given O/D pair.

For the Toll I-5 Only Scenario, of the trips that would be diverted, some would switch to the I-205 bridge for a toll-free ride, while other trips would either be eliminated or consolidated with another trip, thereby reducing the total number of trips crossing the Columbia River. For this study, each of the trip purposes was analyzed separately to determine which trips would be eliminated.

Similarly, trip diversion and trip elimination criteria were analyzed for the Toll I-5 and I-205 Scenario. In this scenario, one-way tolls would be collected on both bridges and trips could not easily divert to another route to avoid the toll. The methodology assumed that there would be no diversion of trips from one bridge to the other due to the tolling of both bridges but that there would be a reduction in trips crossing the river. Since a toll-free route is not an option in this scenario, a greater number of trips would be eliminated due to trip consolidation and/or reduction.

As can be seen in Figure 13, there would be a significant shift from the I-5 bridge to the I-205 bridge if only the I-5 bridge were tolled. Traffic would decrease by 26% on I-5 but increase by 23% on I-205. The combined total on both bridges would decrease by 5% due to trip consolidation or elimination.

In the Toll I-5 and I-205 Scenario, traffic would decrease on both bridges by about 7% due to trip consolidation or elimination.

Variations in Base Toll Rate. Traffic and revenue streams were developed for base toll rates of $2, $3, and $4 in 2004 dollars, adjusted for 3% annual inflation. Revenues were forecast for the two tolling scenarios.

As can be seen in Figures 14 and 15, traffic volumes are lower and revenues are higher in the Toll I-5 and I-205 Scenario than in the Toll I-5 Only Scenario. Traffic volumes are lower in part because more trips are eliminated, and revenues are higher because traffic on both I-5 and I-205 is tolled.

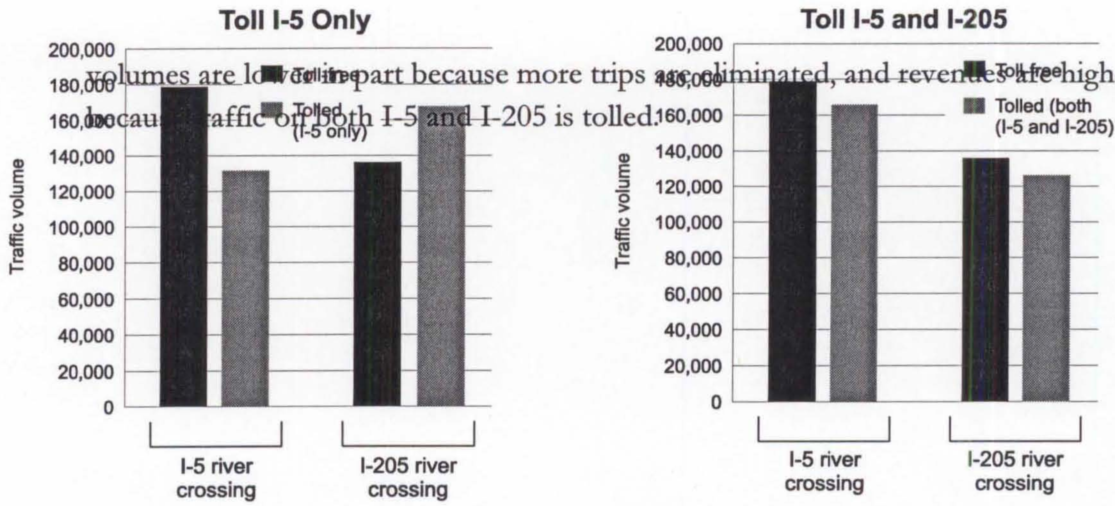

Figure 13. Traffic volumes on the I-5 and I-205 bridges for the toll-free 2020 Build and tolled 2020 Build Options under both tolling scenarios.

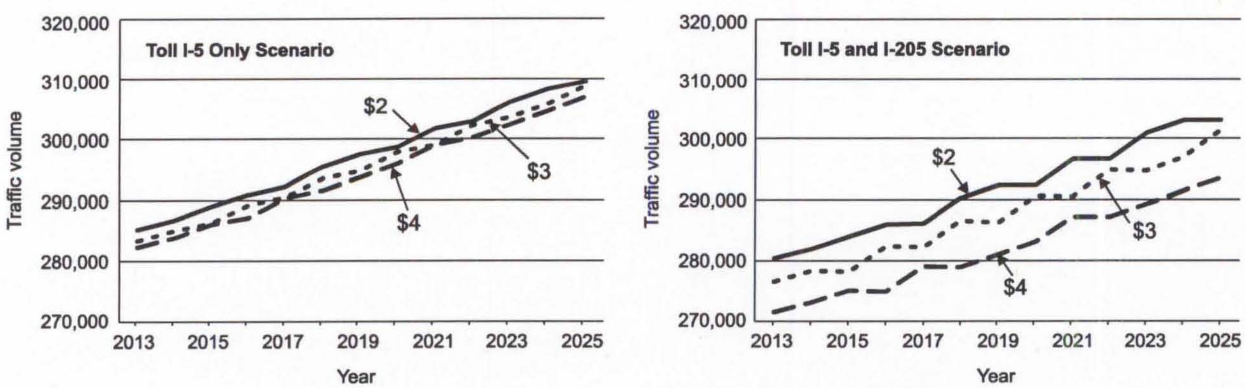

Figure 14. Forecast total traffic volume across the I-5 and I-205 river crossings using base toll rates of $2, $3, and $4 for the two tolling scenarios.

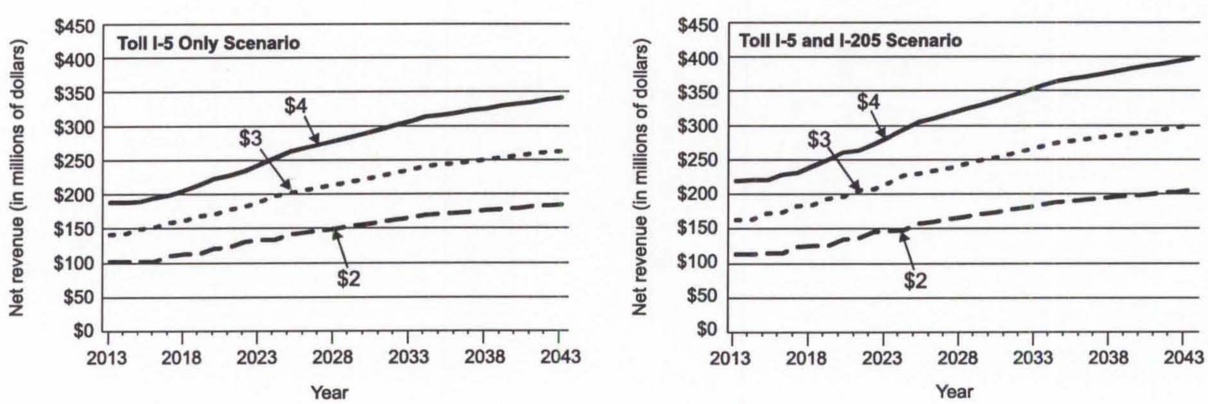

Figure 15. Forecast revenues using base toll rates of $2, $3, and $4 for the two tolling scenarios.

8.3 Forecast Net Revenue

Tolling operations and maintenance typically cost about 20% of gross revenue. Revenue lost during toll collection is assumed to be compensated for by the violation enforcement system.

Net revenues for both tolling scenarios have been forecast for 30 years. The average annual revenue growth rate used in the forecast for 2013 to 2025 was 2.8%; for 2026 to 2035, 2%; and after 2035, 1%. Emme/2 data were used for 2013 to 2020, with projections to 2025. Beyond 2025, the growth rates are conservative estimates. Revenue increases at a higher rate than traffic volume does because toll rates are assumed to increase regularly throughout the forecast period.

Figure 16 shows the 30-year forecast for the Toll I-5 Only Scenario, and Figure 17 shows the forecast for the Toll I-5 and I-205 Scenario.

From Table 5, it can be seen that for the Toll I-5 Only Scenario, net revenues for the $2 base toll range from $101.9 million in 2013 to $184.4 million in 2043. This appears to be a suitable match for a relative capital size of $1 billion to $1.5 billion.

For the Toll I-5 and I-205 Scenario, net revenues are somewhat higher, ranging from $113.4 million in 2013 to $205.5 million in 2043 with a $2 base toll. Again, this appears to be a suitable match for a relative capital size of $1 billion to $1.5 billion.

There is ample room to establish a higher base toll rate for either scenario that would generate additional net revenue and would be capable of funding a capital program greater than $1 billion to $1.5 billion.

8.4 Debt Service

Toll facilities must typically maintain net revenues that are higher than the minimum needed to meet the debt service obligation in order to comply with rating agency and insurer requirements. (Three major rating agencies rate U.S. bonds based on relative risk, and bonds are often insured to access lower bond rates through the purchase of insurance.) The ratio of the net revenue to debt service is known as "coverage." In a simplified example, a project with an annual debt service obligation of $85 million and a coverage ratio of 1.3X (where X is the debt service obligation) would have to maintain annual net revenues of $110 million. In reality, bonds are rarely sold using a level debt service. Rather, the debt service is structured to match annual revenue levels, allowing a lower starting toll level. However, for initial planning, a level debt service review is appropriate to determine the likely range of future tolls.

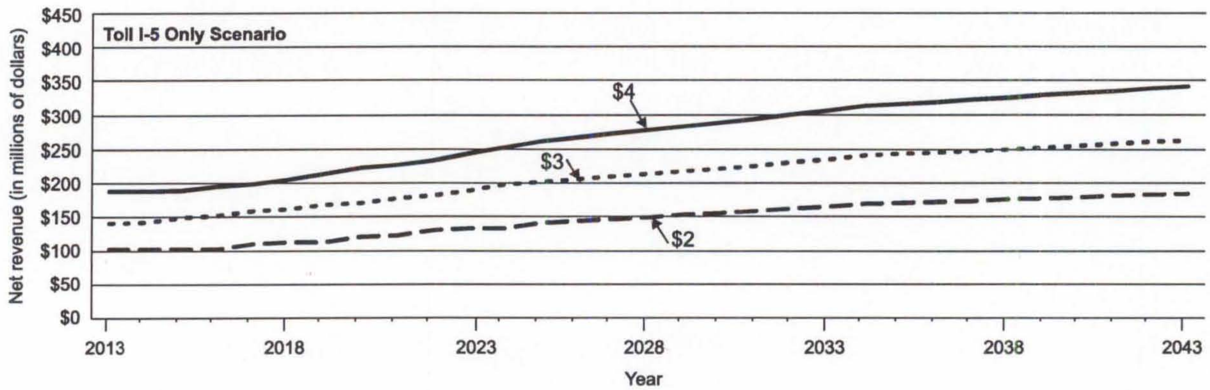

Figure 16. A 30-year forecast of net revenue for the Toll I-5 Only Scenario using base toll rates of $2, $3, and $4.

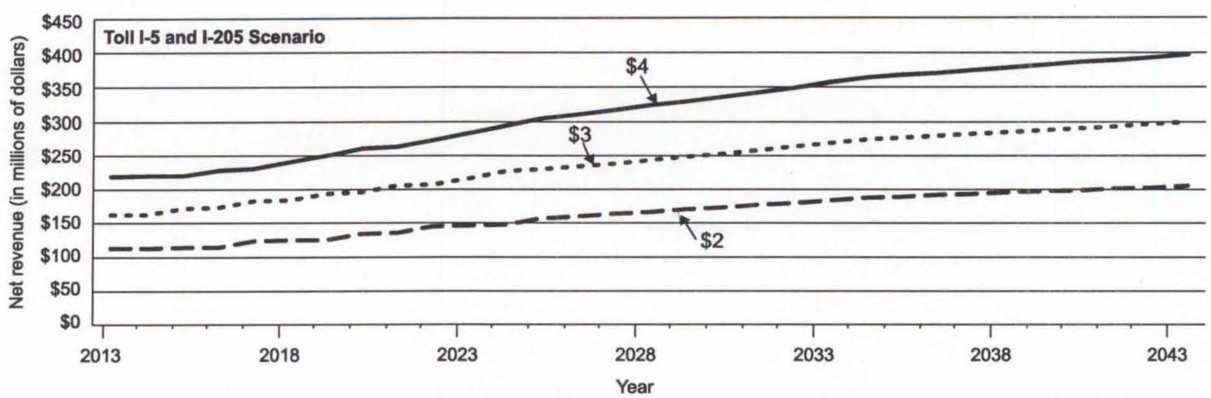

Figure 17. A 30-year forecast of net revenue for the Toll I-5 and I-205 Scenario using base toll rates of $2, $3, and $4.

Table 5. A 30-year forecast of net revenue for both tolling scenarios using base toll rates of $2, $3, and $4.

	Toll I-5 Only Scenario net revenue			Toll I-5 and I-205 Scenario net revenue		
Year	**$2 base toll**	**$3 base toll**	**$4 base toll**	**$2 base toll**	**$3 base toll**	**$4 base toll**
2013	$102 m	$142 m	$188 m	$113 m	$163 m	$220 m
2014	$102 m	$142 m	$189 m	$114 m	$163 m	$220 m
2015	$102 m	$149 m	$189 m	$114 m	$172 m	$220 m
2016	$102 m	$151 m	$195 m	$114 m	$174 m	$229 m
2017	$111 m	$159 m	$199 m	$124 m	$183 m	$231 m
2018	$112 m	$161 m	$205 m	$125 m	$185 m	$240 m
2019	$113 m	$168 m	$214 m	$125 m	$194 m	$251 m
2020	$121 m	$171 m	$223 m	$135 m	$196 m	$261 m
2021	$123 m	$178 m	$227 m	$136 m	$205 m	$263 m
2022	$131 m	$181 m	$233 m	$146 m	$207 m	$272 m
2023	$133 m	$188 m	$243 m	$147 m	$216 m	$283 m
2024	$133 m	$198 m	$252 m	$147 m	$227 m	$294 m
2025	$141 m	$201 m	$262 m	$157 m	$229 m	$305 m
2026	$144 m	$205 m	$267 m	$160 m	$234 m	$311 m
2027	$147 m	$209 m	$272 m	$164 m	$238 m	$317 m
2028	$150 m	$213 m	$278 m	$167 m	$243 m	$323 m
2029	$153 m	$217 m	$283 m	$170 m	$248 m	$330 m
2030	$156 m	$222 m	$289 m	$174 m	$253 m	$336 m
2031	$159 m	$226 m	$295 m	$177 m	$258 m	$343 m
2032	$162 m	$231 m	$300 m	$181 m	$263 m	$350 m
2033	$165 m	$235 m	$306 m	$184 m	$268 m	$357 m
2034	$169 m	$240 m	$313 m	$188 m	$274 m	$364 m
2035	$170 m	$243 m	$316 m	$190 m	$277 m	$368 m
2036	$172 m	$245 m	$319 m	$192 m	$279 m	$371 m
2037	$174 m	$247 m	$322 m	$194 m	$282 m	$375 m
2038	$175 m	$250 m	$325 m	$196 m	$285 m	$379 m
2039	$177 m	$252 m	$329 m	$197 m	$288 m	$382 m
2040	$179 m	$255 m	$332 m	$199 m	$291 m	$386 m
2041	$181 m	$257 m	$335 m	$201 m	$294 m	$390 m
2042	$183 m	$260 m	$338 m	$203 m	$296 m	$394 m
2043	$184 m	$263 m	$342 m	$206 m	$299 m	$398 m
Total	**$4.5 billion**	**$6.5 billion**	**$8.4 billion**	**$5.0 billion**	**$7.4 billion**	**$9.8 billion**

9 Key Findings

9.1 Traffic Analysis

Data used in the I-5 Transportation Study were considered acceptable for performing the tolling analysis and for a preliminary look at the performance of the various river crossing options.

Traffic data used in the tolling analysis could be somewhat conservative, and the forecast traffic volumes and revenues therefore also somewhat conservative. I-205 traffic volumes are forecast to increase at a lower growth rate from 2002 to 2020 than has been experienced over the past decade. Between 1992 and 2003, the average growth rate on I-205 has been about 4.3% per year. However, between 2002 and 2020, the I-205 volumes are expected to increase an average of about 1% per year. If actual traffic growth on I-205 exceeds 1% per year, the tolling revenues could be understated.

New travel demand modeling will need to be undertaken in the development of the EIS. Travel demand forecasts will need to be developed for conditions about 20 years after construction of the project.

9.2 Freeway / Bridge Alternatives

It may be possible to accommodate toll collection facilities in all of the four river crossing improvement concepts that were evaluated in the I-5 Transportation Study, but some concepts would cost less to toll and would be more efficient to operate than others. Alignments using the existing bridges would make toll collection more difficult because of the need for multiple collection facilities on ramps and parallel split roadways. It would be difficult to accommodate toll collection facilities in Concepts 6 and 7 as currently designed.

The four river crossing concepts evaluated in the I-5 Transportation Study should be carried forward into the EIS. If the concepts are evaluated further, the concepts will need to be redesigned around toll collection facilities.

The long and short tunnel crossing options should be dropped from further consideration in the EIS. The tunnel option does not perform as well as other lower-cost river crossing options that provide five lanes in each direction. Traffic demands would create an imbalance based on tunnel lanes providing about 40% of the total I-5 capacity to serve less than 30% of the demand.

The six-lane freeway plus 2 two-lane arterials, one in the vicinity of the I-5 corridor and one in the vicinity of the railroad bridge, should be dropped from consideration in the EIS. To maintain or improve today's level of performance for I-5 by the year 2020, up to two additional lanes of freeway capacity in each direction across the Columbia River will be needed. The arterial-only bridge concepts do not show promise for addressing the corridor's problems.

9.3 Tolling Scenarios

Toll I-5 Only. Tolling the I-5 crossing, but not the I-205 crossing, would change traffic patterns in both the Portland and Vancouver areas. Drivers would take alternate routes if they could to avoid the tolled crossing, potentially shifting substantial traffic to the I-205 crossing and corridor. The timing and amount of shift should be investigated further.

Toll I-5 and I-205. One-way tolling of both the I-5 and the I-205 crossings would minimize shifts in traffic patterns. This option also has the potential to decrease traffic more than the other scenario because a greater number of trips would be eliminated or consolidated since both crossings would be tolled and there would be no free alternative. Further traffic analysis will be required to verify traffic impacts.

9.4 Potential Toll Plaza Sites

One-way tolling. There are no practical northbound toll plaza sites in Washington for the I-5 crossing because the footprint would encroach on historic properties between SR 14 and East Mill Plain. Northbound plaza sites in Oregon appear to have greater potential property impacts than southbound sites for both I-5 and I-205. Southbound toll plazas for I-5 and I-205 in Washington and Oregon are more feasible than northbound toll plazas.

Two-way tolling. The five potential toll plaza sites identified in this study would all accommodate only one-way toll facilities. Assuming that in two-way tolling, the tolling facilities should be close together to share common administration facilities, a two-toll plaza on Hayden Island appears more feasible than for other locations. Placing a two-way toll plaza on Hayden Island would be more costly than other sites due to the high ROW impacts.

Additional investigation would be needed to locate possible sites that would allow for two-way toll collection facilities that could be located opposite each other for ease of access, maintenance, and operation.

Toll plaza site compatibility with river crossing concepts. Concept 4, which provides five new lanes in each direction on a double-deck, replacement bridge, appears to provide the most flexibility for siting a toll plaza. The concepts that use the existing I-5 bridge (Concepts 1, 6, and 7) and Concept 7, because it includes arterials, are less flexible due to split alignments.

9.5 Electronic Toll Collection

Based on current practices, policies, and technology, reliance on 100% electronic toll collection is not likely to be a realistic option for toll collection beginning in year 2013. For this study, it was assumed that tolls would be collected in toll plazas.

9.6 Revenues

Estimated capital costs for constructing a toll plaza range from a low of $110 million on I-205 to a high of $250 million on Hayden Island for the five potential sites that were evaluated. These costs are based on limited design information, are conceptual only, and should therefore not be used for any other purpose than recognizing the magnitude of costs associated with building a toll plaza. Additional evaluation in the EIS is recommended.

Revenues would be higher in the Toll I-5 and I-205 Scenario than in the Toll I-5 Only Scenario in part because traffic on both I-5 and I-205 would be tolled.

For the Toll I-5 Only Scenario, net revenues using a $2 base toll (in 2004 dollars) would range from $102 million in 2013 to $184 million in 2043. The generated revenues appear to be a suitable match for the relative capital size of $1 billion to $1.5 billion

For the Toll I-5 and I-205 Scenario, net revenues using a $2 base toll are somewhat higher, ranging from $113 million in 2013 to $205 million in 2043. Again, the generated revenues appear to be a suitable match for the relative capital size of $1 billion to $1.5 billion.

There is ample room to establish a higher base toll rate for either scenario that would generate additional net revenue and would be capable of funding a capital program greater than $1 billion to $1.5 billion.

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Appendix:
Master List of Working Papers and Technical Memoranda

WP 2.6	Existing Information Data Review for Screening Alternatives and Tolling Options
WP 2.8	I-5 Bridge/Highway Alternatives
WP 3.1	Identification and Evaluation of Toll Models
WP 3.3	Identification and Evaluation of Plaza Operation Models
WP 4.2	Listing of Available and Needed Traffic Data
TM 4.3	Travel and Traffic Characteristics and Trends
WP 5.1	Toll Rate Structure Options
WP 5.2	Toll Collection Options
WP 5.3	Sale/Distribution of Electronic Passes Including Fees and Potential Market Penetration
TM 5.5	Identification of Toll Rate Structure Options and Recommended Assumptions
WP 6.1	Identification and Threshold Analysis of HOV Lane Options
WP 6.2	Identification and Threshold Analysis of Truck Only Lanes
WP 7.1	Evaluation of Toll System Options
WP 8.0	Evaluation of Toll Facility Design Options
WP 10.2	Traffic and Revenue Forecasts for Tolling Options
WP 11.1	Evaluation of I-5 Tolling Alternatives
WP 12.31	Columbia River Crossing Tunnel Options
WP 12.32	Traffic Performance for 6-Lane Freeway Plus Two 2-Lane Arterial Roadways
WP 12.33	Toll Collection Options and Impacts for Bridge Crossing Concept 7
WP 12.34	I-5 and I-205 Deficiencies Analysis